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⑤④ **4"-Keto and-4"-amino-4"-deoxy avermectin compounds and substituted amino derivatives thereof.**

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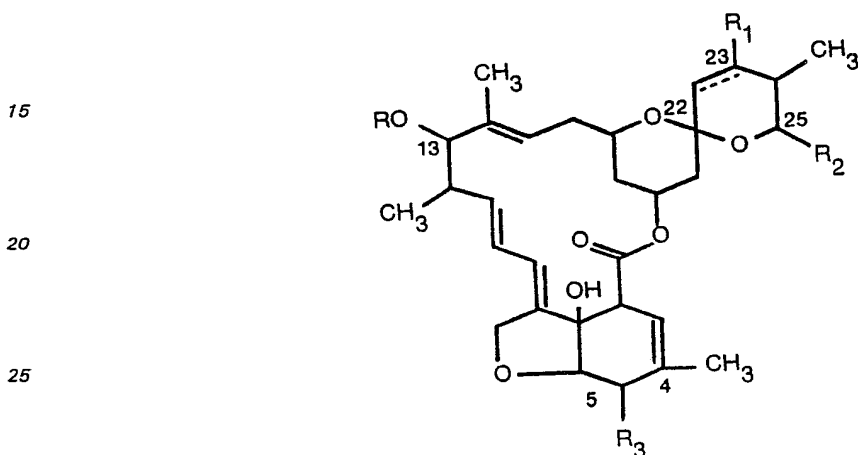
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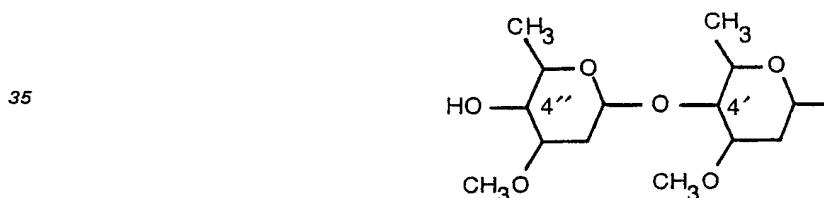
Description

The term avermectin (previously referred to as C—076) is used to describe a series of compounds isolated from the fermentation broth of an avermectin-producing strain of *Streptomyces avermitilis* and its derivatives. The morphological characteristics of the culture are completely described in U.S. Patent No. 4,310,519. The avermectin compounds are a series of macrolides, each of which is substituted at the 13-position with a 4-(α -L-oleandrosyl)- α -L-oleandrose group. The avermectin compounds have a very high degree of anthelmintic and anti-parasitic activity.

The avermectin series of compounds isolated from the fermentation broth have the following structure:



wherein R is the 4'-(α -1-oleandrosyl)- α -1-oleandrose group of the structure:



and wherein the broken line indicates a single or a double bond; R_1 is hydroxy and is present only when said broken line indicates a single bond;

R_2 is *iso*-propyl or *sec*-butyl; and

R_3 is methoxy or hydroxy.

There are eight different avermectin natural product compounds and they are given the designations A1a, A1b, A2a, A2b, B1a, B1b, and B2a based upon the structure of the individual compounds.

In the foregoing structural formula, the individual avermectin compounds are as set forth below. (The R group is 4'-(α -L-oleandrosyl)- α -L-oleandrose):

	R_1	R_2	R_3
A1a	Double Bond	<i>sec</i> -butyl	—OCH ₃
A1b	Double Bond	<i>iso</i> -propyl	—OCH ₃
A2a	—OH	<i>sec</i> -butyl	—OCH ₃
A2B	—OH	<i>iso</i> -propyl	—OCH ₃
B1a	Double Bond	<i>sec</i> -butyl	—OH
B1b	Double Bond	<i>iso</i> -propyl	—OH
B2a	—OH	<i>sec</i> -butyl	—OH
B2b	—OH	<i>iso</i> -propyl	—OH

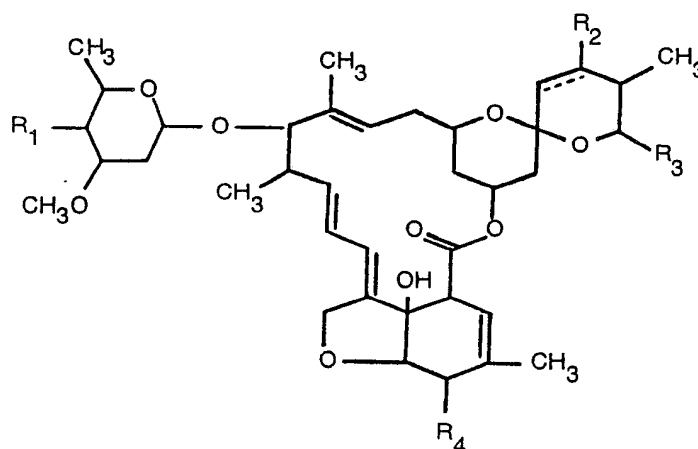
The avermectin compounds are generally isolated as mixtures of a and b components. Such compounds differ only in the nature of the R_2 substituent and the minor structural differences have been found to have very little effect on the isolation procedures, chemical reactivity and biological activity of such compounds.

The end hydroxy group of the disaccharide substituent at the 13-position is situated at what is referred to as the 4''-position. The reactions and substitutions at the 4''-position is the subject matter of the invention.

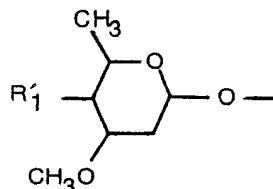
European Patent Specification EP—A—0 008 184 discloses certain avermectin derivatives in which (a) the terminal hydroxy group in the 4''-position of the disaccharide radical II, or (b) the 4'-[4''-(α -L-oleandrosyl)] portion of radical II, or (c) the whole of radical II, is replaced by hydroxy, lower alkanoyloxy or hydrocarbon-oxy.

In the compounds of the present invention, the 4''-hydroxy group is oxidized to keto and may be replaced by an amino or substituted amino group. Such compounds are anti-parasitic agents and anti-bacterial agents.

The compounds of the present invention have the following structural formula



where R_1 is = O, $-\text{NR}_5\text{R}_6$ or



wherein R'_1 is = O, or $-\text{NR}_5\text{R}_6$;

R_5 and R_6 are independently hydrogen, loweralkyl, loweralkanoyl, substituted benzenesulfonyl wherein the substituent is halogen or loweralkyl sulfonyl;

R_2 is hydrogen or hydroxy,

R_3 is *iso*-propyl or *sec*-butyl,

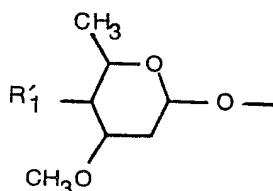
R_4 is hydroxy or methoxy, and the broken line indicates a single or a double bond at the 22,23-position, provided that R_2 is hydroxy only when the broken line indicates a single bond.

The term "loweralkyl" when used in the instant application is intended to represent those alkyl groups either straight or branched chain which have from 1—5 carbon atoms. Examples of such alkyl groups are methyl, ethyl, propyl, *iso*-propyl, butyl, *sec*-butyl, pentyl, and the like.

The term "loweralkanoyl" is intended to include those alkanoyl groups containing from one to five carbon atoms in either a straight or branched chain. Examples of such alkanoyl groups are formyl, acetyl, propenyl, butyryl, valeryl, and the like.

The term "halogen" is intended to include those halogen atoms fluorine, chlorine, bromine and iodine.

One aspect of the preferred compounds of this invention is realized in the above structural formula when R_1 is



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and R'_1 is = O or NR_5R_6 and R_5 and R_6 are independently hydrogen, methyl or acetyl. Further, examples of preferred compounds of the instant invention are:

- 4"-keto avermectin B1a;
- 5 4"-keto avermectin B1b;
- 4"-keto-22,23-dihydro avermectin B1a;
- 4"-keto-22,23-dihydro avermectin B1b;
- 4"-deoxy-4"-amino avermectin B1a;
- 4"-deoxy-4"-amino avermectin B2b;
- 10 4"-deoxy-4"-amino-22,23-dihydro avermectin B1a;
- 4"-deoxy-4"-amino-22,23-dihydro avermectin B1b;
- 4"-deoxy-4"-acetylamino avermectin B1a;
- 4"-deoxy-4"-acetylamino avermectin B1b;
- 4"-deoxy-4"-acetylamino-22,23-dihydro avermectin B1a;
- 15 4"-deoxy-4"-acetylamino-22,23-dihydro avermectin B1b;
- 4"-deoxy-4"-dimethylamino avermectin B1a;
- 4"-deoxy-4"-dimethylamino avermectin B1b;
- 4"-deoxy-4"-dimethylamino-22,23-dihydro avermectin B1a;
- 4"-deoxy-4"-dimethylamino-22,23-dihydro avermectin B1b;
- 20 4"-deoxy-4"-p-chloro benzenesulfonylamino-22,23-dihydro avermectin B1a;
- 4"-deoxy-4"-p-chloro benzenesulfonylamino-22,23-dihydro avermectin B1b;
- 4"-deoxy-4"-(2-methylbenzenesulfonylamino) avermectin B1a;
- 4"-deoxy-4"-(2-methylbenzenesulfonylamino) avermectin B1b.

- 25 The "b" compounds, those with a 25-*iso*-propyl group, are very difficult to separate from the corresponding "a" compound with a 25-*sec*-butyl group and as such the compounds are generally isolated as mixtures of the two compounds. Thus references in the instant application to "a" compounds such as B1a, A1a, and the like, are construed to actually contain a certain proportion of the corresponding "b" compound. Alternatively, this representation of a mixture is sometimes done by referring to the B1 or B2
- 30 compounds or by separating the "a" compound from the "b" compound by a slash (/) such as B1a/B1b, B2a/B2b and the like.

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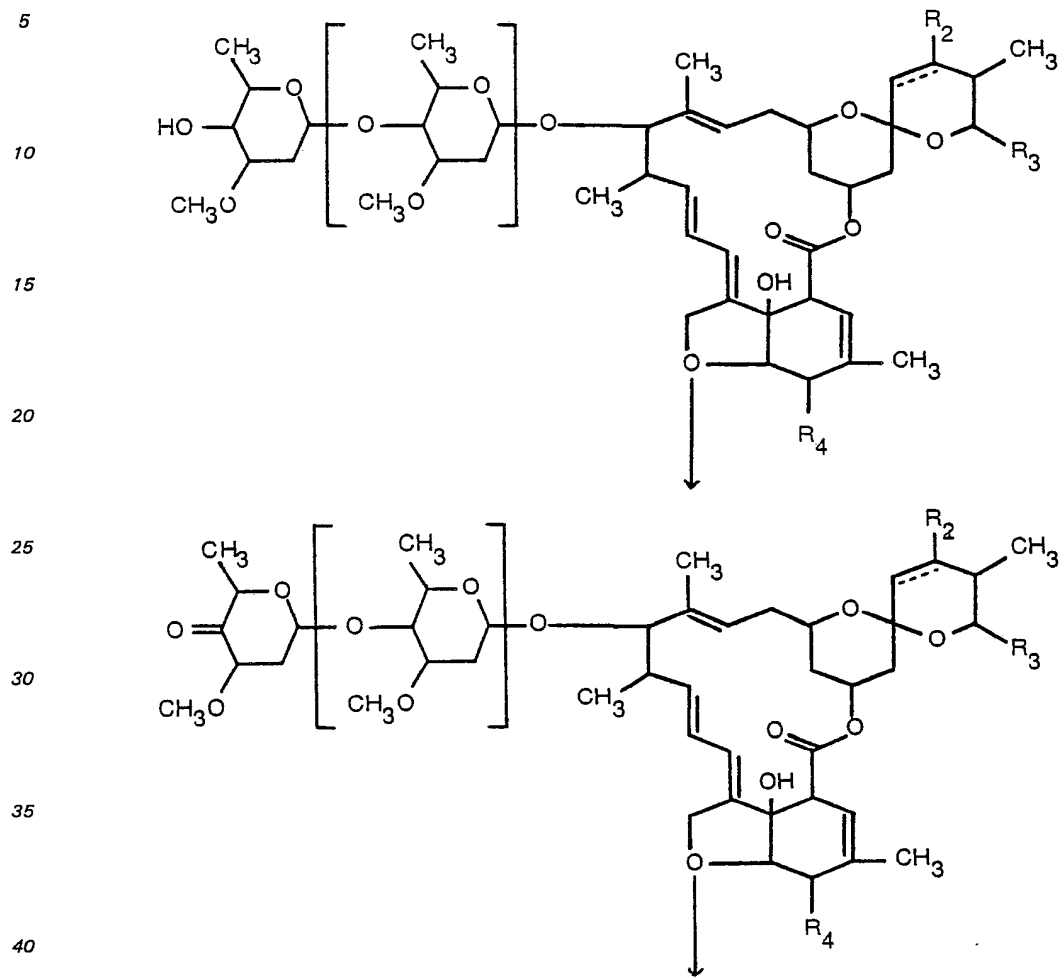
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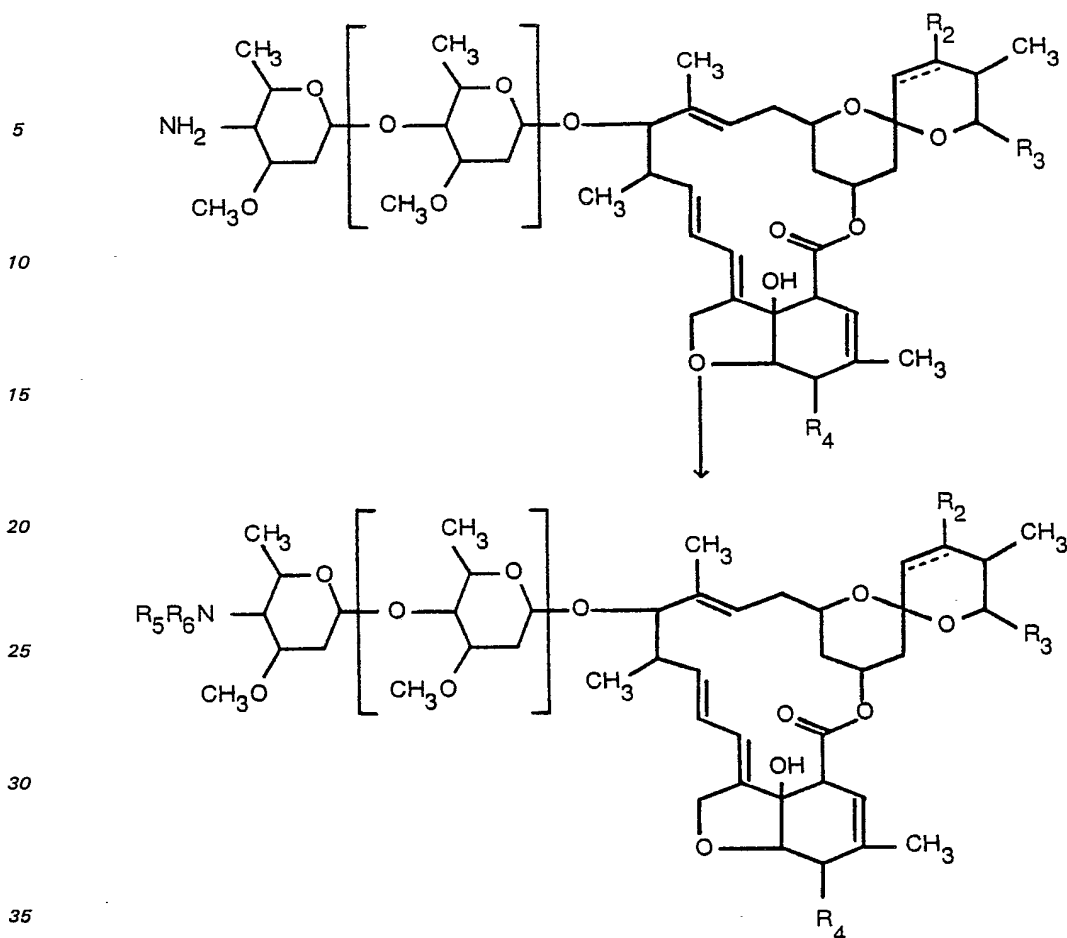
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The compounds of the instant invention are prepared using the procedures exemplified in the following reaction scheme:





wherein

R_2 , R_3 and R_4 are as previously defined and the brackets indicate that the saccharide group containing therein may be either present or absent in the molecule.

In the first step of the foregoing reaction scheme, the avermectin starting materials which may be either the naturally occurring products, the 22,23-dihydro derivatives thereof or the monosaccharide derivative thereof, are oxidized at the 4'-position to the corresponding keto compound. During the procedure the presence of any hydroxy groups at the 5 and 23-positions will require that such hydroxy groups be protected in order that they too are not oxidized. The 7-hydroxy group is very non-reactive and inert and need not be protected. The procedure used to prepare the protected intermediates are described below. The oxidation reaction is carried out in an inert solvent such as methylene chloride using oxalyl chloride or trifluoroacetic anhydride in dimethylsulfoxide as the oxidizing agent. Additionally N-chlorosuccinimide in dimethylsulfide may be employed. The reaction proceeds by dissolving the oxalyl chloride or trifluoroacetic anhydride and dimethylsulfoxide (or other oxidizing reagents) in methylene chloride and cooling to from -50 to -80°C and adding dropwise a methylene chloride solution of the avermectin compound to be oxidized. The addition is carried out over a period of from 15 minutes to 1 hour and then triethylamine is added dropwise over a period of from 1 to 15 minutes. The reaction mixture is then allowed to warm to room temperature over a period of from $\frac{1}{2}$ to 1 hour. The 4'-keto compound is isolated using techniques known to those skilled in the art.

In the next step, the 4'-keto compound is aminated to prepare the unsubstituted amino compound ($R_5=R_6=\text{hydrogen}$). The reaction is carried out in an inert solvent such as methanol at from -25 to $+10^\circ\text{C}$ using ammonium salts and sodium cyanoborohydride as the aminating and reducing reagents. The reaction is complete in from 15 minutes to 2 hours and the product 4'-deoxy-4'-amino compound is isolated using known techniques. Suitable ammonium salts are the acetate, propionate and benzoate. The acetate is preferred.

As a variation to the foregoing amination reaction, methyl ammonium salts could be used in place of the ammonium salts to prepare the monomethyl substituted compound directly. The same reagents, salts and reaction conditions as described above can be used for such a reaction. Other alkyl ammonium salts, and also dialkylammonium salts, can be used in this process.

The introduction of an acyl substituent is carried out using an acylating reagent in the presence of a base in an inert solvent. The preferred acylating reagents are alkanoyl anhydrides, alkanoyl halides, substituted benzene sulfonyl chlorides and alkyl sulfonyl chlorides. The reaction is carried out in an inert solvent such as methylene chloride in the presence of a non-reactive base such as pyridine or triethylamine in order to neutralize the acid produced during the course of the reaction. It may be carried out on a monoalkylamino compound to produce an N-acyl-N-alkylamino compound. The reaction temperature is from -10 to 25°C and the reaction is complete in from 5 minutes to 1 hour. The product is isolated using known techniques.

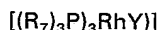
The reaction for the preparation of the 4"-deoxy-4"-dialkylamino compounds is carried out using the alkylating reaction conditions of formaldehyde and a reducing agent such as sodium borohydride, in methanol. The reaction is carried out in aqueous medium using excess aqueous formaldehyde along with the presence of a small amount of acid such as acetic acid to facilitate the reaction. The reaction is carried out at from -10 to +10°C with the solution of the avermectin compound in methanol added dropwise over a period of from 30 to 60 minutes to the alkylating reagent mixture and the product is isolated using known techniques.

PREPARATION OF STARTING MATERIALS

The ultimate starting materials for the compounds of this invention are the avermectin fermentation products defined above. Thus it is apparent that additional reactions are required to prepare the instant compounds. Specifically, reactions are carried out at the 5, 13, 22, and 23-positions. It is generally preferred to prepare whatever substituents are required at these positions before the oxidation at the 4"-hydroxy and subsequent substitution on the thus produced 4"-keto. Such a procedure generally avoids undesirable side reactions. This technique is not required, however, and if desired other sequences may be used. In addition, during the oxidation and substitution reaction described above, it is necessary to protect the hydroxy groups at the 5- and 23-positions to avoid oxidation or substitution at such positions. With these positions protected the reactions may be carried out at the 4"-position without affecting the remainder of the molecule. Subsequent to any of the above described reactions the protecting group may be removed and the unprotected product isolated. The protecting group employed is ideally one which may be readily synthesized, will not be affected by the reactions at the 4"-position and may be readily removed without affecting any other functions of the molecule. One preferred type of protecting group for the avermectin type of molecule is the tri-substituted silyl group, preferably the trialkyl silyl group. One especially preferred example, is the t-butyl dimethylsilyl group. The reaction preparing the protected compound is carried out by reacting the hydroxy compound with the appropriately substituted silylhalide, preferably the silylchloride in an aprotic polar solvent such as dimethylformamide. Imidazole is added as a catalyst. The reaction is complete in from 1 to 24 hours and at from 0 to 25°C. For the 5-position hydroxy group the reaction is complete in from 1/2 to 3 hours at from 0°C to room temperature. This reaction is selective to the 5 position under the conditions above described and very little, if any, silylation is observed at other hydroxy substituted positions. If it is desired to protect the 23-hydroxy group a 4", 5,23-tri(phenoxyacetyl) derivative can be prepared. Basic hydrolysis will leave the highly hindered 23-O-substituent but hydrolyze the 5- and 4"-O-phenoxy acetyl groups. The 5-position is then protected as described above, selectively with t-butyl dimethylsilyl.

The silyl group may be removed after the other contemplated reactions may be carried out. The silyl group or groups are removed by stirring the silyl compound in methanol catalyzed by a catalytic amount of an acid preferably a sulfonic acid such as p-toluene sulfonic acid. The reaction is complete in about 1 to 12 hours at from 0° to 50°C.

Another of the starting materials used in the foregoing reaction scheme are those in which the 22,23 double bond of the "1" type compounds has been reduced to a single bond. As is readily apparent from an analysis of the structure of avermectin starting materials there are 5 unsaturations in the 1-series of compounds. Thus in the one series of compounds it is necessary to reduce the 22,23 double bond while not affecting the remaining four unsaturations or any other functional group present on the molecule in order to selectively prepare the 22,23 dihydro avermectins. It is necessary to select a specific catalyst for the hydrogenation, one that will selectively hydrogenate the least hindered from among a series of unsaturations. The preferred catalyst for such a selective hydrogenation procedure is one having the formula:



wherein

R₇ is loweralkyl, phenyl or loweralkyl substituted phenyl and Y is halogen. The reduction procedure is completely described in U.S. Patent 4,199,569.

The other starting materials which are used in the above reaction scheme involve the preparation of the mono-saccharide compound. That is those compounds wherein one of the α-1-oleandrosyl groups have been removed. The removal of the terminal α-1-oleandrose leaves a hydroxy group at the 4'-position which is equally amenable to the reactions described in the foregoing reaction scheme. Of course in such a case the products prepared are 4'-keto and 4'-deoxy 4'-amino derivatives rather than the 4"-keto and 4"-

deoxy 4"-amino derivatives. The processes which may be used to prepare the monosaccharide derivatives of the avermectin compounds are described in U.S. Patent 4,206,205. The reaction consists generally of treating the starting material disaccharide with acid in an aqueous organic solvent mixture. Water concentrations of from 0.1 to 20% by volume and acid concentrations of from about .01 to .1% will
 5 predominantly produce the monosaccharide product.

A further procedure for the preparation of the monosaccharide utilizes a 1% mineral acid solution in isopropanol at for 20—40°C preferably at room temperature for from 6 to 24 hours. Mineral acids such as sulfuric, hydrohalic, phosphoric and the like may be employed.

The novel compounds of this invention have significant parasitocidal activity as anthelmintics,
 10 ectoparasiticides, insecticides and acaricides, in human and animal health and in agriculture.

The disease or group of diseases described generally as helminthiasis is due to infection of an animal host with parasitic worms known as helminths. Helminthiasis is a prevalent and serious economic problem in domesticated animals such as swine, sheep, horses, cattle, goats, dogs, cats and poultry. Among the helminths, the group of worms described as nematodes causes widespread and often times serious
 15 infection in various species of animals. The most common genera of nematodes infecting the animals referred to above are *Haemonchus*, *Trichostrongylus*, *Ostertagia*, *Nematodirus*, *Cooperia*, *Ascaris*, *Bunostomum*, *Oesophagostomum*, *Chabertia*, *Trichuris*, *Strongylus*, *Trichonema*, *Dictyocaulus*, *Capillaria*, *Heterakis*, *Toxocara*, *Ascaridia*, *Oxyuris*, *Ancylostoma*, *Uncinaria*, *Toxascaris* and *Parascaris*. Certain of these, such as *Nematodirus*, *Cooperia* and *Oesophagostomum* attack primarily the intestinal tract while
 20 others, such as *Haemonchus* and *Ostertagia*, are more prevalent in the stomach while still others such as *Dictyocaulus* are found in the lungs. Still other parasites may be located in other tissues and organs of the body such as the heart and blood vessels, subcutaneous and lymphatic tissue and the like. The parasitic infections known as helminthiasis lead to anemia, malnutrition, weakness, weight loss, severe damage to the walls of the intestinal tract and other tissues and organs and, if left untreated, may result in death of the
 25 infected host. The substituted avermectin compounds of this invention have unexpectedly high activity against these parasites, and in addition are also active against *Dirofilaria* in dogs, *Nematospiroides*, *Syphacia*, *Aspiculuris* in rodents, arthropod ectoparasites of animals and birds such as ticks, mites, lice, fleas, blowfly, in sheep *Lucilia sp.*, biting insects and such migrating dipterous larvae as *Hypoderma sp.* cattle, *Gastrophilus* in horses, and *Cuterebra sp.* in rodents.

The instant compounds are also useful against parasites which infect humans. The most common genera of parasites of the gastro-intestinal tract of man are *Ancylostoma*, *Necator*, *Ascaris*, *Strongyloides*, *Trichinella*, *Capillaria*, *Trichuris*, and *Enterobius*. Other medically important genera of parasites which are found in the blood or other tissues and organs outside the gastrointestinal tract are the filarial worms such as *Wuchereria*, *Brugia*, *Onchocerca* and *Loa*, *Dracunculus* and extra intestinal stages of the intestinal
 35 worms *Strongyloides* and *Trichinella*. The compounds are also of value against arthropods parasitizing man, biting insects and other dipterous pests causing annoyance to man.

The compounds are also active against household pests such as the cockroach, *Blattella sp.*, clothes moth, *Tineola sp.*, carpet beetle, *Attagenus sp.*, and the housefly *Musca domestica*.

The compounds are also useful against insect pests of stored grains such as *Tribolium sp.*, *Tenebrio
 40 sp.* and of agricultural plants such as spider mites, (*Tetranychus sp.*), aphids, (*Acyrtosiphon sp.*); against migratory orthopterans such as locusts and immature stages of insects living on plant tissue. The compounds are useful as a nematocide for the control of soil nematodes and plant parasites such as *Meloidogyne spp.* which may be of importance in agriculture. The compounds are active against other plant pests such as the southern army worm and Mexican bean beetle larvae.

45 These compounds may be administered orally in a unit dosage form such as a capsule, bolus or tablet, or as a liquid drench where used as an anthelmintic in mammals. The drench is normally a solution, suspension or dispersion of the active ingredient usually in water together with a suspending agent such as bentonite and a wetting agent or like excipient. Generally, the drenches also contain an antifoaming agent. Drench formulations generally contains from about 0.001 to 0.5% by weight of the active compound.
 50 Preferred drench formulations may contain from 0.01 to 0.1% by weight. The capsules and boluses comprise the active ingredient admixed with a carrier vehicle such as starch, talc, magnesium stearate, or di-calcium phosphate.

Where it is desired to administer the avermectin derivatives in a dry, solid unit dosage form, capsules, boluses or tablets containing the desired amount of active compound usually are employed. These dosage
 55 forms are prepared by intimately and uniformly mixing the active ingredient with suitable finely divided diluents, fillers, disintegrating agents and/or binders such as starch, lactose, talc, magnesium stearate, vegetable gums and the like. Such unit dosage formulations may be varied widely with respect to their total weight and content of the antiparasitic agent depending upon factors such as the type of host animal to be treated, the severity and type of infection and the weight of the host.

60 When the active compound is to be administered via an animal feedstuff, it is intimately dispersed in the feed or used as a top dressing or in the form of pellets which may then be added to the finished feed or optionally fed separately. Alternatively, the antiparasitic compounds of our invention may be administered to animals parenterally, for example, by intraruminal, intramuscular, intratracheal, or subcutaneous injection in which event the active ingredient is dissolved or dispersed in a liquid carrier vehicle. For
 65 parenteral administration, the active material is suitably admixed with an acceptable vehicle, preferably of

the vegetable oil variety such as peanut oil, cotton seed oil and the like. Other parenteral vehicles such as organic preparation using solketal, glycerol formal, and aqueous parenteral formulations are also used. The active avermectin compound or compounds are dissolved or suspended in the parenteral formulation for administration; such formulations generally contain from 0.005 to 5% by weight of the active compound.

Although the antiparasitic agents of this invention find their primary use in the treatment and/or prevention of helminthiasis, they are also useful in the prevention and treatment of diseases caused by other parasites, for example, arthropod parasites such as ticks, lice, fleas, mites and other biting insects in domesticated animals and poultry. They are also effective in treatment of parasitic diseases that occur in other animals including humans. The optimum amount to be employed for best results will, of course, depend upon the particular compound employed, the species of animal to be treated and the type and severity of parasitic infection or infestation. Generally good results are obtained with our novel compounds by the oral administration of from about 0.001 to 10 mg per kg of animal body weight, such total dose being given at one time or in divided doses over a relatively short period of time such as 1—5 days. With the preferred compounds of the invention, excellent control of such parasites is obtained in animals by administering from about 0.025 to 0.5 mg per kg of body weight in a single dose. Repeat treatments are given as required to combat re-infections and are dependent upon the species of parasite and the husbandry techniques being employed. The techniques for administering these materials to animals are known to those skilled in the veterinary field.

When the compounds described herein are administered as a component of the feed of the animals, or dissolved or suspended in the drinking water, compositions are provided in which the active compound or compounds are intimately dispersed in an inert carrier or diluent. By inert carrier is meant one that will not react with the antiparasitic agent and one that may be administered safely to animals. Preferably, a carrier for feed administration is one that is, or may be, an ingredient of the animal ration.

Suitable compositions include feed premixes or supplements in which the active ingredient is present in relatively large amounts and which are suitable for direct feeding to the animal or for addition to the feed either directly or after an intermediate dilution or blending step. Typical carriers or diluents suitable for such compositions include, for example, distillers' dried grains, corn meal, citrus meal, fermentation residues, ground oyster shells, wheat shorts, molasses solubles, corn cob meal, edible bean mill feed, soya grits, crushed limestone and the like. The active hydrogenated avermectin compounds are intimately dispersed throughout the carrier by methods such as grinding, stirring, milling or tumbling. Compositions containing from about 0.005 to 2.0% by weight of the active compound are particularly suitable as feed premixes. Feed supplements, which are fed directly to the animal, contain from about 0.002 to 0.3% by weight of the active compounds.

Such supplements are added to the animal feed in an amount to give the finished feed the concentration of active compound desired for the treatment and control of parasitic diseases. Although the desired concentration of active compound will vary depending upon the factors previously mentioned as well as upon the particular avermectin derivative employed, the compounds of this invention are usually fed at concentrations of between 0.00001 to 0.002% in the feed in order to achieve the desired antiparasitic result.

The avermectin compounds of this invention are also useful in combatting agricultural pests that inflict damage upon crops while they are growing or while in storage. The compounds are applied using known techniques as sprays, dusts, emulsions and the like, to the growing or stored crops to effect protection from such agricultural pests.

In using the compounds of this invention, the individual substituted avermectin components may be prepared and used in that form. Alternatively, mixtures of two or more of the individual avermectin components may be used, as well as mixtures of the parent avermectin compounds, other avermectin compounds or other active compounds not related to avermectin, with the compounds of this invention.

The 4"-amino and substituted amino compounds of the present invention are valuable antibiotics active against various Gram-positive and Gram-negative bacteria and accordingly find utility in human and veterinary medicine. Representative pathogens which are sensitive to the instant compounds include: *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Bacillus subtilis*, *Salmonella typhosa*, *Pseudomonas* and *Bacterium proteus*. The antibacterials of the invention are not limited to utility as medicaments; they may be used in all manner of industry, for example: additives to animal feed, preservation of food, disinfectants, and in other industrial systems where control of bacterial growth is desired. For example, they may be employed in aqueous compositions in concentrations ranging from 0.1 to 100 parts of antibiotic per million parts of solution in order to destroy or inhibit the growth of harmful bacteria on medical and dental equipment and as bactericides in industrial applications, for example in waterbased paints and in the white water of paper mills to inhibit the growth of harmful bacteria.

The products of this invention may be used in any of a variety of pharmaceutical preparations. They may be employed in capsule, powder form, in liquid solution, or in suspension. They may be administered by a variety of means; those of principal interest include: orally, topically or parenterally by injection (intravenously or intramuscularly).

Such tablets and capsules, designed for oral administration, may be in unit dosage form, and may contain conventional excipients, such as binding agents, for example, syrup, acacia, gelatin, sorbitol,

tragacanth, or polyvinylpyrrolidone; fillers, for example, lactose, sugar, cornstarch, calcium phosphate, sorbitol, or glycerine; lubricants, for example, magnesium stearate, talc, polyethylene glycol, silica; disintegrants, for example, potato starch, acceptable wetting agents such as sodium lauryl sulphate. The tablets may be coated according to methods well known in the art. Oral liquid preparations may be in the form of aqueous or oily suspensions, or solutions, or they may be presented as a dry product for reconstitution with water or other suitable vehicle before use. Such liquid preparations may contain conventional additives such as suspending agents, for example, sorbitol, methyl cellulose, glucose/sugar syrup, gelatin, hydroxyethylcellulose, or carboxymethyl cellulose. Suppositories will contain conventional suppository bases, such as cocoa butter or other glycerides.

Compositions for injection, the preferred route of delivery, may be prepared in unit dosage form in ampules, or in multidose containers. The compositions may take such forms as suspensions, solutions, or emulsions in oily or aqueous vehicles, and may contain formulatory agents. Alternatively, the active ingredient may be in powder form for reconstitution, at the time of delivery, with a suitable vehicle, such as sterile water.

The compositions may also be prepared in suitable forms for absorption through the mucous membranes of the nose and throat or bronchial tissues and may conveniently take the form of liquid sprays or inhalants, lozenges, or throat paints. For medication of the eyes or ears, the preparation may be presented in liquid or semi-solid form. Topical applications may be formulated in hydrophobic or hydrophilic bases as ointments, creams, lotions, paints, or powders.

The dosage to be administered depends to a large extent upon the condition and size of the subject being treated as well as the route and frequency of administration — the parenteral route by injection being preferred for generalized infections. Such matters, however, are left to the routine discretion of the therapist according to principles of treatment well known in the antibiotic art. In general, a daily dosage consists of from about 0.1 to about 5 mg of active ingredient per kg. of body weight of the subject in one or more treatments per day. A preferred daily dosage for adult humans lies in the range of from about 0.1 to 20 mg. of active ingredient per kg. of body weight. Another factor influencing the precise dosage regimen, apart from the nature of the infection and peculiar identity of the individual being treated, is the molecular weight of the chosen species of this invention.

The compositions for human delivery per unit dosage, whether liquid or solid, may contain from 0.1% to 99% of active material, the preferred range being from about 10—60%. The composition will generally contain from about 5 mg. to about 50 mg. of the active ingredient; however, in general, it is preferable to employ a dosage amount in the range of from about 5 mg to 100 mg. In parenteral administration, the unit dosage is usually the pure compound I in sterile water solution or in the form of a soluble powder intended for solution.

In the isolation of the avermectin compounds, which serve as starting materials for the instant processes, from the fermentation broth, the various avermectin compounds will be found to have been prepared in unequal amounts. In particular an "a" series compound will be prepared in a higher proportion than the corresponding "b" series compound. The difference between the "a" series and "b" series is constant throughout the avermectin compounds and consists of a *sec*-butyl group and an *iso*-propyl group respectively at the 25 position. This difference, of course, does not interfere with any of the instant reactions. In particular it may not be necessary to separate the "b" components from the related "a" component. Separation of these closely related compound is generally not practiced since the "b" compound is present only in a very small percent by weight, and the structural difference has negligible effect on the reaction processes and biological activities.

In particular it has been found that the starting materials for the compounds of this invention are very often prepared in a ratio of about 80% avermectin B1a or A1a and 20% avermectin B1b or A1b. Thus the preferred composition of this invention is one which contains about 80% of the "a" component and 20% of the "b" component.

The following examples are provided in order that this invention might be more fully understood; they are not to be construed as limitative of the invention.

The substituted avermectin derivatives prepared in the following examples are generally isolated as amorphous solids and not as crystalline solids. They are thus characterized analytically using techniques such as mass spectrometry, nuclear magnetic resonance, and the like. Being amorphous, the compounds are not characterized by sharp melting points, however, the chromatographic and analytical methods employed indicate that the compounds are pure.

In the following examples, the various starting materials therefor are avermectin compounds or derivatives of avermectin compounds. The avermectin compounds and the preparation and isolation thereof from fermentation broths are described in United States Patent No. 4,310,519 issued 12 January 1982. The selective 22,23-dihydro derivatives of avermectin compounds are described in U.S. Patent 4,199,569 issued 22 April 1980. The monosaccharide derivatives of avermectin compounds are described in U.S. Patent 4,206,205 issued 3 January 1980.

Example 1

5-O-t-butyl-dimethylsilyl-22,23-dihydro avermectin B1a/B1b
3 g 22,23-dihydro avermectin B1a/B1b in 30 ml of dry dimethylformamide was combined with 1.4 g of

imidazole and stirred at room temperature until all the materials had dissolved. Then 1.56 g of t-butyl-dimethylsilyl chloride was added and the reaction mixture stirred at room temperature for 70 minutes. The reaction mixture was diluted with 150 ml of ether, water was added and the layers were separated. The aqueous layer was extracted twice more with ether and the combined ether layers washed four times with water and once with saturated sodium chloride solution. The ether layer was dried over magnesium sulfate and concentrated to dryness *in vacuo* affording 4.2 g of a white foam. The foam is chromatographed on 135 g. of 70—230 mesh silica gel and eluted with 5% tetrahydrofuran in methylene chloride. 1.15 G of 4"-5-di-O-t-butyl-dimethylsilyl-22,23-dihydro avermectin B1a/B1b and 2.6 g of 5-O-t-butyl dimethylsilyl-22,23-dihydro avermectin B1a/B1b were recovered as pure amorphous foams.

Example 2

5-O-t-butyl-dimethylsilyl-4"-keto-22,23-dihydro-avmerectin B1a/B1b

In a dried flask purged with dry nitrogen was placed 97 μ l of oxalyl chloride and 1.5 ml of methylene chloride. The reaction mixture was cooled to -60°C , 1 ml of the methylene chloride solution containing 160 μ l of dimethylsulfoxide was added over a period of 3 minutes and the reaction mixture stirred at -60°C for two minutes. 3 ml of methylene chloride containing 500 mg of 5-O t-butyl dimethylsilyl 22,23-dihydro avermectin B1a/B1b was added dropwise over a period of 5 minutes and the reaction mixture stirred at room temperature for 30 minutes. At the end of this period, 0.71 ml of triethylamine was added dropwise and the reaction mixture was stirred at -60°C for 5 minutes. The cold bath was removed and the reaction mixture was allowed to come to room temperature over a period of 45 minutes. 50 ml of water was added and the reaction mixture was extracted 3 times with 40 ml of ether. The ether extracts were combined and washed 4 times with 20 ml of water, dried over magnesium sulfate and concentrated to dryness *in vacuo* affording 520 mg of a yellow glass. The yellow glass was dissolved in methylene chloride and placed on three 2,000 μ silica gel preparative layer chromatography plates. The plates were developed with 10% ethyl acetate in methylenechloride and afforded 470 ml of yellow foam which was characterized by its 300 MHz nuclear magnetic resonance spectrum as 5-O-t-butyl-dimethylsilyl-4"-keto-22,23-dihydro avermectin B1a/B1b.

Example 3

5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-amino-22,23-dihydro avermectin B1a/B1b

Into a dried flask was placed 200 mg of 5-O-t-butyl-dimethylsilyl-4"-keto-22,23-dihydroavermectin B1a/B1b 2 ml of methanol, 160 mg of ammonium acetate and 12 mg of sodium cyanoborohydride. The reaction mixture was stopped and stirred at room temperature for 100 minutes. The reaction mixture was added to a 10 ml solution of saturated sodium carbonate diluted 1 to 1 with water to afford a gummy precipitate. The precipitate was extracted 4 times with 3 ml of ethyl acetate and the ethyl acetate layers were combined and washed four times with 1 ml of water. The organic layer was dried over magnesium sulfate and evaporated to dryness in a stream of nitrogen to afford 198 mg of yellow opaque glass. The glass was dissolved in methylene chloride and placed on three 1,000 μ silica gel preparative layer chromatography plates and eluted with 7% methanol in methylene chloride to afford 19 mg of a yellow glass which was identified by 300 MHz nuclear magnetic resonance as 5-O-t-butyl-dimethylsilyl-4'-dioxy-4"-amino-22,23-dihydro avermectin B1a/B1b and 64 mg of a yellow glass which was identified by 300 MHz nuclear magnetic resonance as 5-O-t-butyl-dimethylsilyl-4"-dioxy-4"-epiamino-22,23-dihydro avermectin B1b/B1b.

Example 4

4"-deoxy-4"-amino-22,23-dihydro-avermectin B1a/B1b

17 mg of 5-O t-butyl-dimethylsilyl-4"-deoxy-4"-amino-22,23-dihydro avermectin B1a/B1b was dissolved in a few drops of methanol and cooled in an ice-bath with stirring. 3 ml of 1% (weight to volume), p-toluene sulfonic acid hydrate solution in methanol was added and the reaction mixture stirred for 55 minutes. The reaction mixture was added to dilute sodium bicarbonate solution and extracted 3 times with 3 ml portions of ethyl acetate. The organic layers were combined and washed 3 times with 1 ml of water and once with saturated sodium chloride solution. The organic layer was dried over magnesium sulfate and evaporated to dryness under a stream of nitrogen affording 18 mg of a yellow glass. The yellow glass was dissolved in methylene chloride and placed on a 250 μ silica gel preparative layer chromatography plate and eluted with 8% methanol in methylene chloride. The band with an Rf of 0.20 afforded 8.5 mg of a white glass. Mass spectrometry and 300 MHz nuclear magnetic resonance identified it as 4"-deoxy-4"-amino-22,23-dihydroavermectin B1a/B1b.

Example 5

4"-deoxy-4"-epi-amino-22,23-dihydro avermectin B1a/B1b

Following the procedure of Example 4 using 60 mg of 5-O-t-butyl-dimethylsilyl 4"-deoxy-4"-epi-amino-22,23-dihydro avermectin B1a/B1b 6.0 ml of 1% weight to volume p-toluene sulfonic acid hydrate in methanol there was obtained 27.4 mg of 4"-deoxy-4"-epi-amino-22,23-dihydro avermectin B1a/B1b which structure was confirmed by mass spectrometry and 300 MHz nuclear magnetic resonance.

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Example 6

5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-acetylamino-22,23-dihydro avermectin B1a/B1b

30 mg of 5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-amino-22,23-dihydro avermectin B1a/B1b was combined with 0.5 ml of methylene chloride and cooled in an ice-bath. 6 Drops of pyridene was added followed by 2 Drops of acetic anhydride. The reaction mixture was stirred at 0°C for 30 minutes. Water and ether were added, the layers were separated and the aqueous layer extracted again with ether. The organic layers were combined and washed four times with 1 ml portions of water, dried over magnesium sulfate and evaporated to dryness under a stream of nitrogen to afford 35 mg of a yellow glass. The yellow glass was dissolved in methylene chloride and placed on a 500 μ silica gel preparative layer chromatography plate and eluted with a 1 to 1 mixture of ethyl acetate in methylene chloride to afford 14.6 mg of off-white foam. 300 MHz nuclear magnetic resonance characterized the material as 5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-acetylamino-22,23-dihydro-avermectin B1a/B1b.

Example 7

4"-deoxy-4"-acetylamino-22,23-dihydro avermectin B1a/B1b

Following the procedure of Example 4, 4"-acetylamino-4"-deoxy-5-O-t-butyl-dimethylsilyl-22,23-dihydro-avermectin B1a/B1b was treated with a 1% solution of p-toluenesulfonic acid monohydrate in methanol (w/v) to give after isolation and purification 4"-acetylamino-4"-deoxy-22,23-dihydro-avermectin B1a/B1b.

Example 8

5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-epi-acetylamino-22,23-dihydro-avermectin B1a/B1b

Following the procedure of Example 6 wherein 5 mg of 5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-epi-amino-22,23-dihydro avermectin B1a/B1b was employed, there was obtained 5-O-t-butyl-dimethylsilyl 4"-deoxy-4"-epi-acetylamino-22,23-dihydro avermectin B1a/B1b.

Example 9

4"-deoxy-4"-epi-acetylamino-22,23-dihydro-avermectin B1a/B1b

Following the procedure of Example 4 in which 35 mg of 5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-epi-acetylamino-22,23-dihydro avermectin B1a/B1b was employed with 4 ml of 1% weight to volume p-toluene sulfonic acid hydrate in methanol. There was obtained 19.4 mg of 4"-deoxy-4"-epi-acetylamino-22,23-dihydro-avermectin B1a/B1b.

Example 10

4"-keto-22,23-dihydro-avermectin B1a/B1b

25 mg of 5-O-t-butyl-dimethylsilyl-4"-keto-22,23-dihydro-avermectin B1a/B1b in 3 mg of 1% weight to volume p-toluene sulfonic acid hydrate in methanol was stirred at room temperature for 20 minutes. 20 ml of water was added and the reaction mixture extracted three times with 15 ml portions of ether. The ether layers were combined and washed three times with 3 ml portions of water dried over magnesium sulfate and evaporated to dryness *in vacuo* to afford 15 mg of a colorless glass. The glass was dissolved in methylene chloride and placed on a 1000 μ silica gel preparative layer chromatography plate and eluted with 5% methanol in methylene chloride to afford 14.5 mg of an off-white glass characterized by mass spectrometry and 300 MHz nuclear magnetic resonance as 4"-keto 22,23-dihydro-avermectin B1a/B1b.

Example 11

5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-epi-N,N-dimethylamino-22,23-dihydro avermectin B1a/B1b

50 mg of 5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-epi-amino-22,23-dihydro-avermectin B1a/B1b was dissolved in 0.7 ml of methanol and 0.4 ml of acetic acid added followed by 0.5 ml of 37% aqueous formaldehyde solution. The reaction mixture was stirred at room temperature for 30 minutes, cooled in an ice bath and 130 mg of sodium borohydride was added in 5—10 mg portions with 5—10 minutes separating each portion. Vigorous foaming accompanied each addition. A saturated sodium bicarbonate solution was added in small portions to the reaction mixture to neutrality followed by extraction with ether. The aqueous layer was extracted twice more with 20 ml portions of ether. The ether layers were combined and washed four times with 4 ml portions of water. The combined organic layers were dried over magnesium sulfate and evaporated to dryness *in vacuo* affording 40 ml of a slightly yellow glass. The glass was dissolved in methylene chloride and placed on a 1000 μ silica gel preparative layer chromatography plate and developed with ethyl acetate to afford 30.5 mg of yellow glass identified by mass spectrometry as 5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-epi-N,N-dimethylamino-22,23-dihydro avermectin B1a/B1b.

Example 12

4"-deoxy-4"-epi-N,N-dimethylamino-22,23-dihydro-avermectin B1a/B1b

29 Mg of 5-O-t-butyl-dimethylsilyl-4"-deoxy-4"-epi-N,N-dimethylamino-22,23-dihydro avermectin B1a/B1b was treated with 3 ml of 1% weight to volume p-toluene sulfonic acid hydrate in methanol following the procedure of Example 4. There was afforded 15.8 mg of a white glass which was identified by mass spectrometry and 300 MHz nuclear magnetic resonance as 4"-deoxy-4"-epi-N,N-dimethylamino-22,23-dihydro-avermectin B1a/B1b.

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Example 13

5-O-t-Butyldimethylsilyl-4"-deoxy-4"-(4-chlorophenylsulfonylamino)-22,23-dihydroavermectin-B1a/B1b

A solution of 100 mg of 5-O-t-butyldimethylsilyl-4"-deoxy-4"-amino-22,23-dihydroavermectin B1a/B1b is dissolved in 2 ml of methylenechloride and treated with 70 mg of triethylamine and 45 mg of 4-chlorobenzenesulfonylchloride at room temperature for 16 hrs. The usual work-up gives 5-O-t-butyldimethylsilyl-4"-deoxy-4"-(4-chlorophenylsulfonylamino)-22,23-dihydroavermectin-B1a/B1b in pure form.

Example 14

4"-Deoxy-4"-(4-chlorophenylsulfonylamino)-22,23-dihydroavermectin-B1a/B1b

100 Mg of 5-O-t-butyldimethylsilyl-4"-deoxy-4"-(4-chlorophenylsulfonylamino)-22,23-dihydroavermectin-B1a/B1b is treated according to Example 4 with a solution of 1% of p-toluenesulfonic acid monohydrate in methanol for 30 min at room temperature affording 4"-deoxy-4"-(4-chlorophenylsulfonylamino)-22,23-dihydroavermectin-B1a/B1b in pure form.

Example 15

4"-Keto-5-O-t-butyldimethylsilylvermectin-B1a/B1b

If avermectin B1a/B1b is reacted according to the procedures of Example 1 and 2 4"-keto-5-O-t-butyldimethylsilylvermectin-B1a/B1b is obtained.

Example 16

4"-Keto-avermectin-B1a/B1b

If the product of Example 15 is reacted according to the procedure of Example 10, 4"-ketoavermectin-B1a/B1b is obtained.

Example 17

4"-Amino-4"-deoxyavermectin B1a/B1b

If the product of Example 15 is reacted according to the procedures of Examples 3 and 4 4"-amino-4"-deoxyavermectin B1a/B1b is obtained.

Example 18

4"-Acetylamino-4"-deoxavermectin B1a/B1b

If the product of Example 15 is reacted according to the procedures of Examples 3, 6 and 7 4"-acetylamino-4"-deoxavermectin B1a/B1b is obtained.

Example 19

4'-Keto-5-O-t-butyldimethylsilyl-22,23-dihydroavermectin B1a/B1b monosaccharide

If 22,23-dihydroavermectin B1a/B1b-monosaccharide is reacted according to the procedures of Examples 1 and 2 4'-keto-5-O-t-butyldimethylsilyl-22,23-dihydroavermectin B1a/B1b monosaccharide is obtained.

Example 20

4'-Keto-22,23-dihydroavermectin B1a/B1b-monosaccharide

If the product of Example 19 is reacted according to the procedures of Example 10 4'-keto-22,23-dihydroavermectin B1a/B1b-monosaccharide is obtained.

Example 21

4'-Amino-4'-deoxy-22,23-dihydroavermectin-B1a/B1b-monosaccharide

If the product of Example 19 is reacted according to the procedures of Examples 3 and 4, 4'-amino-4'-deoxy-22,23-dihydroavermectin-B1a/B1b-monosaccharide is obtained.

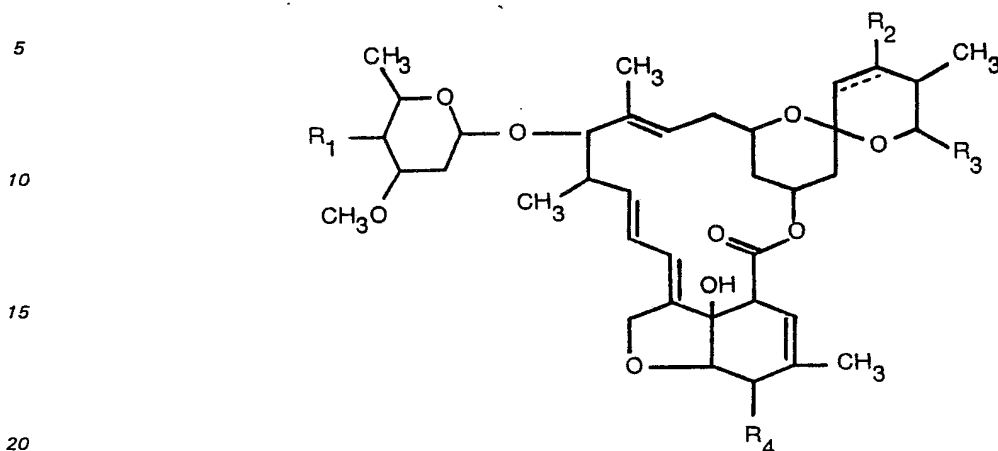
Example 22

4'-Acetylamino-4'-deoxy-22,23-dihydroavermectin-B1a/B1b-monosaccharide

If the product of Example 19 is reacted according to the procedures of Examples 3, 6 and 7, 4'-acetylamino-4'-deoxy-22,23-dihydroavermectin-B1a/B1b-monosaccharide is obtained.

Claims

1. A compound having the formula:



where R_1 is = O, $-\text{NR}_5\text{R}_6$ or



in which R_1' is = O or $-\text{NR}_5\text{R}_6$ and each of R_5 and R_6 , which are the same or different, is a hydrogen atom or a C_{1-5} alkyl, C_{1-5} alkanoyl, halogen-substituted benzenesulfonyl or C_{1-5} alkylsulfonyl radical; R_2 is a hydrogen atom or a hydroxy radical; R_3 is a *sec*-butyl or *iso*-propyl radical; R_4 is a hydroxy or methoxy radical; and the broken line indicates that the 22,23 position is either singly or doubly bonded, provided that R_2 can only be hydroxy when the broken line indicates a single bond.

2. A compound as claimed in Claim 1 in which R_1 is



3. A compound as claimed in Claim 1 in which R_1 is



where each of R_5 and R_6 , which are the same or different is a hydrogen atom or methyl or acetyl radical.

4. A process for the preparation of a compound as claimed in Claim 1 in which R_1 or R_1' is =O, comprising treating a compound of the formula set forth in Claim 1 but in which R_1 or R_1' , as the case may be, is hydroxy, with oxalyl chloride or trifluoroacetic anhydride in dimethyl sulfoxide, or with *N*-chlorosuccinimide in dimethylsulfide.

5. A process for the preparation of a compound as claimed in Claim 1 in which R_1 or R_1' is $-\text{NR}_5\text{R}_6$, where R_5 and R_6 are as defined in Claim 1, comprising treating the corresponding compound in which R_1 or R_1' is =O with an ammonium salt or alkylated ammonium salt and a reducing agent to produce a

compound as claimed in Claim 1 in which R_1 or R'_1 is $-\text{NR}_2$, where each R is alkyl or hydrogen, and optionally treating the latter with acylating agent capable of introducing a C_{1-5} alkanoyl, halogen-substituted benzenesulfonyl or C_{1-5} alkylsulfonyl radical in the presence of a base to produce a 4''-deoxy-4''-(acylated amino) or 4'-deoxy-4'-(acylated amino) compound or optionally treating the amino compound (i.e. that in which $\text{R}=\text{R}'=\text{H}$) with aqueous formaldehyde and a reducing agent under acidic conditions to produce the corresponding 4''-deoxy-4''-N,N-dimethylamino or 4'-deoxy-4'-N,N-dimethyl-amino compound.

6. A process as claimed in Claim 5 in which the alkylated ammonium salt is a methyl ammonium salt.

7. A compound of Claim 1 for use in the treatment of parasitic infections.

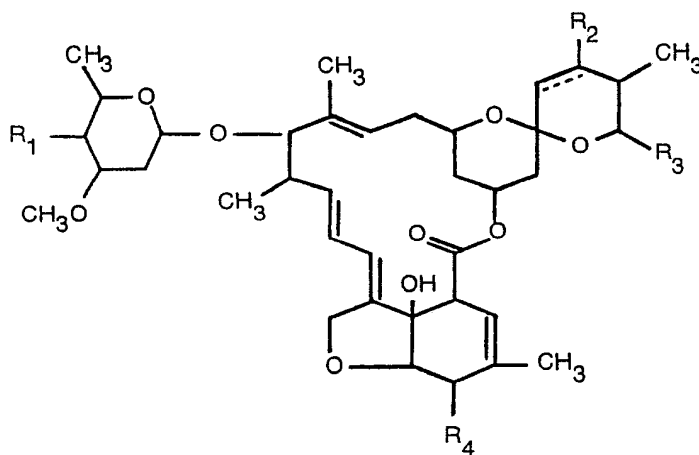
8. A composition useful for treating animals infected with parasites comprising an inert carrier and a compound as claimed in Claim 1.

9. A compound as claimed in Claim 1 in which R_1 or R'_1 is $-\text{NR}_5\text{R}_6$ and R_5 and R_6 are as defined in Claim 1, for use in the treatment of bacterial infections.

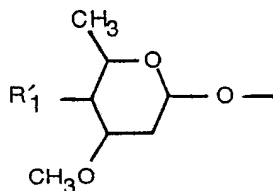
10. A composition useful for treating bacterial infections comprising an inert carrier and a compound as claimed in Claim 1 in which R_1 or R'_1 is $-\text{NR}_5\text{R}_6$ and R_5 and R_6 are as defined in Claim 1.

Revendications

1. Un composé ayant pour formule:

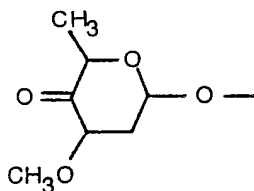


dans laquelle R_1 est $=\text{O}$, $-\text{NR}_5\text{R}_6$ ou

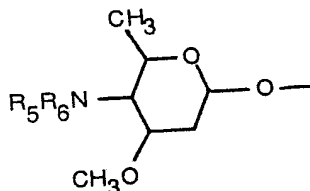


où R'_1 est $=\text{O}$ ou $-\text{NR}_5\text{R}_6$ et chacun de R_5 et R_6 , qui sont semblables ou différents, est un atome d'hydrogène ou un radical alkyle en C_{1-5} , alcanoyl en C_{1-5} , benzène-sulfonyl halogéno-substitué ou alkylsulfonyl en C_{1-5} ; R_2 est un atome d'hydrogène ou un radical hydroxy; R_3 est un radical sec-butyle ou isopropyle; R_4 est un radical hydroxy ou méthoxy; et le pointillé indique que la position 22,23 correspond soit à une simple liaison, soit à une double liaison, sous réserve que R_2 ne peut être qu'un hydroxy lorsque le pointillé correspond à une simple liaison.

2. Un composé comme revendiqué dans la revendication 1 dans lequel R_1 est



3. Un composé comme revendiqué dans la revendication 1 dans lequel R_1 est



où chacun de R_5 et R_6 qui sont semblables ou différents, est un atome d'hydrogène ou un radical méthyle ou acétyle.

4. Un procédé pour la préparation d'un composé comme revendiqué dans la revendication 1, dans lequel R_1 ou R'_1 est = O, comprenant le traitement d'un composé répondant à la formule indiquée dans la revendication 1, mais où R_1 ou R'_1 , selon le cas, est un hydroxy, avec le chlorure d'oxalyle ou l'anhydride trifluoroacétique dans le diméthylsulfoxyde ou avec le N-chlorosuccinimide dans le sulfure de diméthyle.

5. Un procédé pour la préparation d'un composé comme revendiqué dans la revendication 1, où R_1 ou R'_1 est $-NR_5R_6$, où R_5 et R_6 sont comme définis dans la revendication 1, comprenant le traitement du composé correspondant où R_1 ou R'_1 est = O, avec un sel d'ammonium ou un sel d'ammonium alkylé et un agent réducteur pour produire un composé comme revendiqué dans la revendication 1 où R_1 ou R'_1 est $-NR_2$, où chaque R est un alkyle ou un hydrogène, et éventuellement le traitement de ce dernier avec un agent d'acylation capable d'introduire un radical alcanoylé en C_{1-5} , benzènesulfonyle halogéno-substitué ou alkylsulfonyle en C_{1-5} en présence d'une base pour produire un composé 4''-désoxy-4''-(amino acylé) ou 4'-désoxy-4' (amino acylé), ou éventuellement le traitement du composé amino (c'est-à-dire dans lequel $R=R=H$) avec du formaldéhyde aqueux et un agent réducteur en conditions acides pour produire le composé 4''-désoxy-4''-N,N-diméthylamino ou 4'-désoxy-4'-N,N-diméthylamino correspondant.

6. Un procédé comme revendiqué dans la revendication 5 dans lequel le sel d'ammonium alkylé est un sel de méthylammonium.

7. Un composé de la revendication 1 pour l'emploi dans le traitement des infections parasitaires.

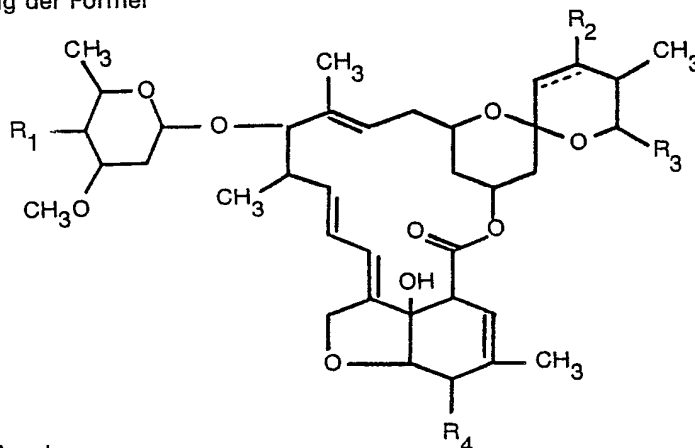
8. Une composition utile pour le traitement des animaux infectés par des parasites comprenant un support inerte et un composé comme revendiqué dans la revendication 1.

9. Un composé comme revendiqué dans la revendication 1 dans lequel R_1 ou R'_1 est $-NR_5R_6$ et R_5 et R_6 sont comme définis dans la revendication 1, pour l'emploi dans le traitement des infections bactériennes.

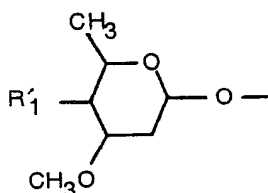
10. Une composition utile pour le traitement des infections bactériennes comprenant un support inerte et un composé comme revendiqué dans la revendication 1 où R_1 ou R'_1 est $-NR_5R_6$ et R_5 et R_6 sont comme définis dans la revendication 1.

Patentansprüche

1. Eine Verbindung der Formel

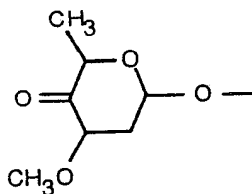


worin $R_1 = O, -NR_5R_6$ oder



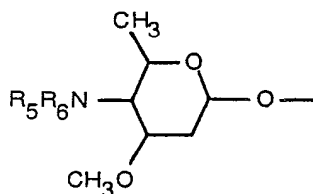
ist, worin $R_1' = O$ oder $-NR_5R_6$ ist, und jedes von R_5 und R_6 , die gleich oder verschieden sind, ein Wasserstoffatom oder ein C_{1-5} -Alkyl-, C_{1-5} Alkanoyl-, Halogen-substituierter Benzolsulfonyl- oder C_{1-5} Alkylsulfonyl-Rest ist; R_2 ein Wasserstoffatom oder ein Hydroxy-Rest ist; R_3 ein sec-Butyl oder Isopropyl-Rest ist; R_4 ein Hydroxy- oder Methoxy-Rest ist; und die unterbrochene Linie anzeigt, daß die 22,23-Stellung entweder einfach oder doppelt gebunden ist, vorausgesetzt, daß R_2 nur Hydroxy sein kann, wenn die unterbrochene Linie eine einfache Bindung darstellt.

2. Eine Verbindung, wie in Anspruch 1 beansprucht, worin R_1



ist.

3. Eine Verbindung, wie in Anspruch 1 beansprucht, worin R_1



ist, worin jedes von R_5 von R_6 die gleich oder verschieden sind, ein Wasserstoffatom oder Methyl- oder Acetyl-Rest ist.

4. Ein Verfahren zur Herstellung einer Verbindung, wie in Anspruch 1 beansprucht, worin R_1 oder $R_1' = O$ ist, umfassend die Behandlung einer Verbindung der Formel, angegeben in Anspruch 1, in der jedoch R_1 oder R_1' , je nach Bedarf, Hydroxy ist, mit Oxalylchlorid oder Trifluoressigsäureanhydrid in Dimethylsulfoxid oder mit N-Chlorsuccinimid in Dimethylsulfid.

5. Ein Verfahren zur Herstellung einer Verbindung, wie in Anspruch 1 beansprucht, worin R_1 oder $R_1' = -NR_5R_6$ ist, worin R_5 und R_6 wie in Anspruch 1 definiert sind, umfassend die Behandlung der entsprechenden Verbindung, worin R_1 oder $R_1' = O$ ist, mit einem Ammoniumsalz oder alkylierten Ammoniumsalz und einem Reduktionsmittel, zur Herstellung einer Verbindung, wie in Anspruch 1 beansprucht, in der R_1 oder $R_1' = -NR_2$ ist, worin jedes R Alkyl oder Wasserstoff ist, und gegebenenfalls Behandeln der letzteren mit Acylierungsmittel, das zur Einführung eines C_{1-5} Alkanoyl-, Halogen-substituierten Benzolsulfonyl- oder C_{1-5} Alkylsulfonyl-Rests geeignet ist, in Anwesenheit einer Base, zur Herstellung einer 4''-Desoxy-4''-(acyliertes-amino)- oder 4'-Desoxy-4'-(acyliertes-amino)-Verbindung, oder gegebenenfalls Behandeln der Aminoverbindung (d.h., die in der $R = R = H$) mit wäßrigem Formaldehyd und einem Reduktionsmittel unter sauren Bedingungen, zur Herstellung der entsprechenden 4''-Desoxy-4''-N,N-dimethylamino- oder 4'-Desoxy-4'-N,N-dimethylamino-Verbindung.

6. Ein Verfahren, wie in Anspruch 5 beansprucht, bei dem das alkylierte Ammoniumsalz ein Methylammoniumsalz ist.

7. Eine Verbindung nach Anspruch 1 zur Verwendung bei der Behandlung von Parasiteninfektionen.

8. Eine Zusammensetzung, geeignet zur Behandlung von Tieren, die mit Parasiten infiziert sind, umfassend einen inerten Träger und eine Verbindung, wie in Anspruch 1 beansprucht.

9. Eine Verbindung, wie in Anspruch 1 beansprucht, in der R_1 oder $R_1' = -NR_5R_6$ ist und R_5 und R_6 wie in Anspruch 1 definiert sind, zur Verwendung bei der Behandlung von Bakterieninfektionen.

10. Eine Zusammensetzung, geeignet zur Behandlung von Bakterieninfektionen, umfassend einen inerten Träger und eine Verbindung, wie in Anspruch 1 beansprucht, in der R_1 oder $R_1' = -NR_5R_6$ ist und R_5 und R_6 wie in Anspruch 1 definiert sind.